Center Independent Research & Development: GSFC IRAD

Development of Highly Reproducible and Robust Absorber Coatings for Bolometric Detector Arrays

Completed Technology Project (2015 - 2017)

Project Introduction

We will develop fabrication processes to realize controlled impedance absorber coatings for bolometric sensor applications. Although there are a variety of different coatings currently employed with existing detector assemblies, they are either difficult to integrate or do not meet the science requirements over envisioned mission lifecycles. We will demonstrate absorbers with highly reproducible and lasting properties applicable for general use in the microwave through the infrared.

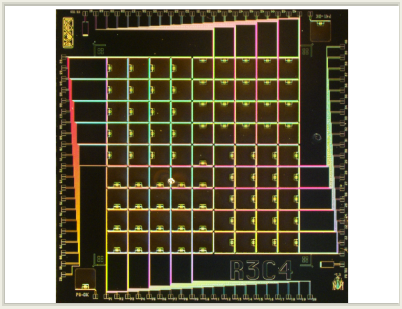
Our objective is to develop controlled impedance absorbers operating in the mid-to-far infrared spectral band (20 microns and long ward). These absorbers are critical components in a large number of planned terrestrial (e.g., GISMO 2), balloon borne (e.g., BETTII and PIPER), airborne (e.g., HAWC+ and HIRMES), and future space missions. Unfortunately, existing coatings are either difficult to reproduce, incompatible with other sensor processing steps, or susceptible to aging. These attributes result in schedule delays and/or a reduction of science because of a transient optical efficiency over the instrument lifetime**.**

Our near term goal is to develop an absorber material for HIRMES, which requires delivery of flight focal plane arrays prior to April 2017 in order for the instrument build to be completed on schedule. A NbTiN absorber has been baselined for HIRMES, because Fourier Transform Spectrometer measurements of absorber prototypes have shown that this material is resistive at relevant frequency (~15 THz), has a low residual stress (which is required in order to achieve optimal optical coupling), and has a superconducting transition temperature > 10K. This last attribute is important for a background-limited instrument like HIRMES, because the NbTiN acts like a high pass filter. At frequency < 750GHz, the absorber is invisible, and, consequently, there is significantly lower radiation loading on the detectors.

We will coat the NbTiN films with ultrathin dielectric coatings in order to passivate them against aging in ambient conditions, and if these films are acceptable, we will have, for the first time, developed broadband coatings that are robust and immune to aging after annealing encountered during detector fabrication and over the course of an instrument development and deployment lifecycle (~years at ambient temperature).

Anticipated Benefits

This technology will fill a technological gap for some future mid-to-far infrared instruments with bolometric sensor focal plane arrays with back-short under grid (BUG) and related sensor architectures.



The BETTII (Balloon Experimental Twin Telescope for Infrared Interferometry) 9x9 bolometric detector array needs broadband absorbers to operate.

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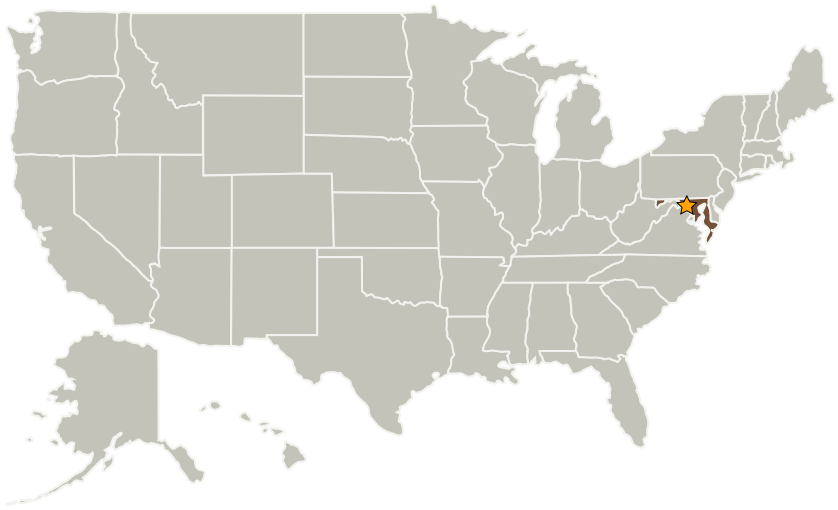
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Goddard Space Flight Center(GSFC)	Lead Organization	NASA Center	Greenbelt, Maryland
Johns Hopkins University	Supporting Organization	Academia	Baltimore, Maryland

Primary U.S. Work Locations
Maryland

Project Transitions

October 2015: Project Start

Organizational Responsibility

Responsible Mission Directorate:

Mission Support Directorate (MSD)

Lead Center / Facility:

Goddard Space Flight Center (GSFC)

Responsible Program:

Center Independent Research & Development: GSFC IRAD

Project Management

Program Manager:

Peter M Hughes

Project Managers:

Terence A Doiron
Timothy D Beach
Megan E Eckart

Principal Investigator:

Ari D Brown

Co-Investigator:

Kevin H Miller

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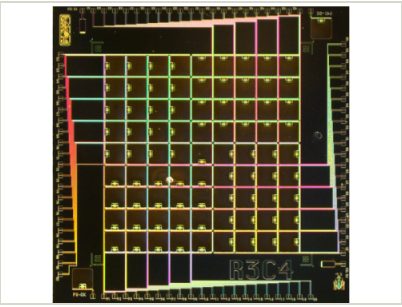
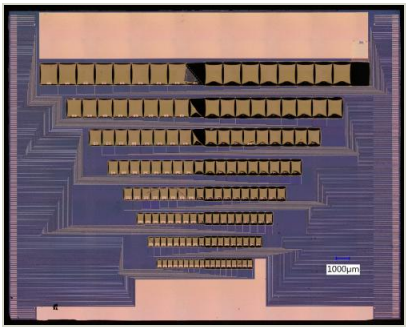
September 2017: Closed out

Closeout Summary: The purpose of the Goddard Space Flight Center's Internal Research and Development (IRAD) program is to support new technology development and to address scientific challenges. Each year, Principal Investigators (PIs) submit IRAD proposals and compete for funding for their development projects. Goddard's IRAD program supports eight Lines of Business: Astrophysics; Communications and Navigation; Cross-Cutting Technology and Capabilities; Earth Science; Heliophysics; Planetary Science; Science Small Satellites Technology; and Suborbital Platforms and Range Services.Task progress is evaluated twice a year at the Mid-term IRAD review and the end of the year. When the funding period has ended, the PIs compete again for IRAD funding or seek new sources of development and research funding or agree to external partnerships and collaborations. In some cases, when the development work has reached the appropriate Technology Readiness Level (TRL) level, the product is integrated into an actual NASA mission or used to support other government agencies. The technology may also be licensed out to the industry.The completion of a project does not necessarily indicate that the development work has stopped. The work could potentially continue in the future as a follow-on IRAD; or used in collaboration or partnership with Academia, Industry and other Government Agencies.If you are interested in partnering with NASA, see the TechPort Partnerships documentation available on the TechPort Help tab. http://techport.nasa.gov/help

Images



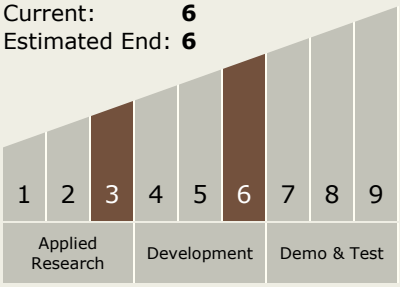
BETTII 9x9 Bolometric Detector Array
The BETTII (Balloon Experimental Twin Telescope for Infrared Interferometry) 9x9 bolometric detector array needs broadband absorbers to operate.
(https://techport.nasa.gov/image/19113)



HIRMES High Resolution Detector Array
The HIRMES High Resolution Detector Array requires ultra-low stress, superconducting, impedance matched absorber coatings in order to achieve its science goals.
(https://techport.nasa.gov/image/24476)

Technology Maturity (TRL)

Start: **3**
Current: **6**
Estimated End: **6**



Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.1 Remote Sensing Instruments/Sensors
    - TX08.1.1 Detectors and Focal Planes

Target Destinations

Outside the Solar System, Foundational Knowledge

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Links

GSC-17157-1
(https://ntts.arc.nasa.gov/app/)

GSC-17240-1
(https://ntts.arc.nasa.gov/app/)

Project Website:

http://sciences.gsfc.nasa.gov/sed/